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The following gentlemen were elected members:

Dr. John C. Spear, U. S. N.; Jas. Lanman Harmar; Dr. Fausto E. Rendon.

The following were elected Correspondents:

Prof. A. Kolliker, of Wurzburg, and N. H. Bishop.

The Committee to which was referred the paper by Alphonzo Wood, entitled "On Brevoortia," reported in favor of its publication in the Journal.

On favorable report of the Committee, the following papers were ordered to be published:

The Auroral Display of April 15, 1869.

BY J. ENNIS.

This auroral display was the brightest that has appeared at Philadelphia since the memorable one on the evening of August 28, 1859. On both these occasions the light was most beautiful and striking, and during the interval between the two no display occurred at all to be compared to these in brightness, in beauty, in variety of coloring, and in general grandeur and magnificence of view. They both began just as the twilight was dying away. The former slightly exceeded in gorgeous coloring, and the latter in duration, for it continued to be still strikingly grand until after midnight. On both occasions the chief colors were pale rose and pale green, but though pale in tint they were very bright, clear and impressive.

The cause of the aurora borealis is generally admitted to be the passage of electricity from the northern region of the globe toward the south. This passage I suppose to be CONSTANT, and in THREE DIFFERENT PATHS: the lower, through the surface of the earth; the middle, along the top of the atmosphere; and the higher, along what are called the magnetic curves; the earth being considered as a great magnet, with the poles north and south.

The lower path becomes evident by studying the disturbances of the magnetic needle. Mr. Charles V. Walker came to the conclusion, from magnetic irregularities, that over the south-eastern portion of the New England States there is a stream of electricity of indefinite width drifting across the country, moving to and fro in a line from N. 42 E. to S. 42 W.* Professor Loomis, of Yale College, in discussing the great auroral display of 1859, says he found similar magnetic disturbances over the continent of Europe, and that they are propagated in a direction from N. 28 E. to S. 28 W. He intimates that perhaps more observations would show the directions in Europe and America to be the same.† Probably the electric currents on both continents would be found floating more nearly north and south. All the facts of these magnetic disturbances coincide with the idea that the electric stream is through the earth's surface, the actual position of the magnets irregularly deflected.

The necessity for such a current through the earth's surface southwardly becomes evident from the fact that the solid portion of the globe is constantly robbing the atmosphere of its electricity. We behold the tendency of this fluid to come down in a thunder shower; and sometimes, though rarely, the thunder and lightning will fall from a cloud without any rain. I know an instance, witnessed by several credible persons in the north-eastern part of New Jersey, where a lightning stroke, with a loud report, and without any rain, fell from a small summer cloud and struck one of the cattle in the field, which had a bell at its neck. The solder of the bell was partly melted, and the animal was killed. In all ordinary good weather, the higher we ascend in the air the more strongly do we find it charged with electricity. The under side of any stratum, say two hundred feet thick, is always negative to the upper side; and at the same time it is positive to the upper side of a stratum directly below. The lower side of this lower stratum is positive to the solid earth below, which is negative to the air above. From this condition in the air, and the relative condition between the air and the ground, there must be a constant passage of electricity more or less from the atmosphere to the earth. As the extra accumulation is at the north, it must go south through the earth for the equilibrium. This extra accumulation in the north is proved by the visible aurora borealis.

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* Amer. Journ. Sci. and Arts, vol. 32, p. 326.

† Ibid, p. 334.

The second path southward of the superabundant electricity at the north is along the top, or through the exceedingly rare upper regions of the atmosphere. The auroral arch has in some cases been found to be about forty miles above the earth's surface. We may say it is at or near the top of the atmosphere possessing an appreciable density. This arch always moves towards the south. While it moves it seems to part with portions of itself in the form of "streamers,"—far extending lines upward,—in the directions of the magnetic curves. The "streamers" cease to be visible before they reach low southern latitudes, and so does the arch; but the want of visibility, either in the streamers or in the arch, is no reason why the electric fluid does not continue to flow in both cases towards the equator. Streamers cannot be supposed to rise from the arch in the lower latitudes, because there the magnetic curves coincide so nearly with the horizon; and the parting of the streamers may perhaps cause the visibility of the arch.

Nearly twenty years ago I had a very distinct view of the electric fluid flashing along the top of the atmosphere. It consisted of sheets of flame, thin and broken, darting from north to south. I was standing on the back platform of the last car of a train travelling from New York to Newark, N. J., where I then resided. The sky was perfectly clear, and I think, though I am not certain, it was bright moonlight. I remember very distinctly that no aurora borealis was seen,—at least such as the aurora generally appears. But in looking towards the east I saw at intervals bright patches of flame shooting from north to south. These fiery patches were not the mild faint glow of the ordinary aurora, but bright like flame, though very much broken and ragged, evidently very thin, and about eight or ten degrees in diameter. Their course before disappearance ran through an arc a little longer. It was as though something was passing rapidly through the atmosphere along its top, and by friction was grating fire now and then as it passed. A few others saw the display, and I believed then, as I believe now, that I saw the frictional effect of the electric fluid against the atmosphere while flowing from the polar toward the equatorial regions. The direction of the passage was not towards the zenith to form a corona, but from north to south, while appearing in the eastern sky at an elevation of from 30 to 40 degrees.

During the display of April 15, 1869, one of the most remarkable features was the quick passage of flakes of the light glowing aurora from the northern horizon to the zenith, and sometimes fifteen or twenty degrees beyond. The transfer of the electric matter through this entire space occupied only the fraction of a second. For distinctness of appearance I could not help comparing these passages with those of breezes of wind across the surface of the water, or over a wheat field when seen from a neighboring elevation. As there are successive flaws of wind, one chasing another, so there were successive and frequent flaws or discharges of electricity. The next day an observer, quite a young man, remarked to me that it was wonderful to see the white clouds rise up from the north and fly swiftly overhead. This very rapidity, moving through such an arc in a fraction of a second, shows these clouds to have been electric. It was impossible for me then to conceive how they could have been mere flashes of light. They were not intense in brightness like those I saw twenty years ago, but the pale auroral glow as seen in the artificial auroral tube. I gazed at them long and often, with the profound conviction that I actually saw electricity, whatever that may be, transferred bodily from north to south. But did these mild but swift electric clouds take the path along the top of the atmosphere, or along the magnetic curves? They were certainly quite distinct from the tall continuous streamers. I incline to believe that they ran along the top of the atmosphere, and that they were nearer than the streamers. But by mere vision the relative nearness of such objects cannot well be distinguished; we cannot tell the relative nearness of a planet and a fixed star by simple inspection, although the one may be several hundred thousand times farther off than the other.

In Prof. Loomis's description of the great auroral display of Aug. 28, 1859, he records some very remarkable observations, and reproduces the diagrams showing the deflected course pursued by some streams and flashes of electricity.* Such tortuous streams would be impossible in the magnetic curves. But they are what should be occasionally looked for when the electric fluid passes through and over the upper regions of the atmosphere. That atmosphere we know is composed of various strata and various currents, some dry and some moist, some moving one way and some another, and some charged with electricity more than others. Therefore a stream of electricity floating through or over the rare upper regions of the atmosphere, and meeting these various strata and currents, must be affected differently, and sometimes made to produce just such curved phenomena as are presented in those descriptions.

Lightning down the side of a tree takes a tortuous path from the grain of the wood, or even of the bark.

The upper path, the magnetic curves far away above the atmosphere, pursued by the electric fluid in passing from the north to the south, I do not now discuss. Like many other kindred auroral topics, it is not within the scope of this short paper. That path has been ably treated by B. V. Mersh, Esq., of this city, and by Prof. Loomis of Yale College, when describing the great auroral display of 1859 in the American Journal of Science and Arts, where both those gentlemen have given references to other authors.

The CONSTANT passage of the electric fluid from north to south is indicated by the frequent irregular deflections of the magnetic needle, and by the frequent auroral displays in high northern latitudes. Prof. Loomis portrays a zone around the northern region of the globe, where the aurora is seen eighty times in a year, as the highest maximum average. But this number seems to me to be too small. Many observers speak of their appearance almost nightly. In latitude 70° N., at Bossekop, in Alten Bay, on the coast of West Finmark, M. Lottin observed one hundred and forty-three auroras during an interval of two hundred and six days, between September, 1838, and April, 1839. During the long night of seventy times twenty-four hours, from Nov. 17 to Jan. 25, the aurora was visible sixty-four times. On other occasions within that same period, when the sight of the aurora was impossible on account of thick clouds, it was proved to exist by disturbances of the magnetic needle. At Fort York, in 1780, Umfreville says "there were very few nights without an aurora." Chapell in 1814, when giving his experience, says "the nights were constantly illumined by the aurora." Henderson says he saw the auroras in Iceland in 1814–15 almost every clear night. Such is the testimony of others, but in this short paper I cannot quote. In Prof. Loomis's collections about the great display in 1859, several similar expressions may be found, and also in the collection of Mr. Peter Force in the 8th volume of the Smithsonian Contributions. During the summer of 1868 I spent six weeks on the Saguenay river or its near vicinity in Canada, being part of the time at Grand Bay and Chicoutimi, more than a hundred miles due north of Quebec. There the aurora appeared almost every evening; indeed, its appearance was the rule and its absence the exception. But the displays were not strikingly grand. I remarked that on the Saguenay they were much more frequent than when I was at Montreal, either the same summer or in that of 1858, when I spent more than a month in or near that city. That difference of latitude, about three degrees, made what appeared to me a disproportionate difference in the frequency of auroral displays,—a difference, however, not as great as that between Montreal and Philadelphia, which is again a difference of latitude about five and a half degrees.

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* Am. Journal of Science and Arts, vol. 31, pp. 84, 85.

In high northern latitudes the auroral phenomena are rendered invisible a very large part of the year by twilight. At Montreal the twilight lasts until 10 o'clock and begins at 2; and on the Saguenay it ends at 11 o'clock and begins at 1. In latitude near 60° N. many years ago, in the month of June, I could read very easily at midnight by the light of the sun, which luminary seemed, by his bright rosy reflections against the clouds, to be but very little below the northern horizon. Plainly there can be but little chance for the electric aurora to shine among the rosy fingers of the due northern solar aurora. As in those regions the electric process causing the aurora occurs almost every night when there is little or no twilight, so we may presume the same process continues when a strong twilight hides the boreal aurora, especially since we know that auroras may be indicated by the magnetic needle when they are not actually visible to the eye. Our present reports from the far north lead to the supposition that the auroral process is more frequent on some meridians of longitude than on others, and that it is effected by geographical causes. Probably also many reporters, being exploring travellers and not scientific observers, have thought the fainter and less conspicuous auroras unworthy of record; and hence Prof. Loomis' small number of eighty per annum for the maximum average in any zone.

Both Capt. Franklin and Dr. Richardson testify that "the auroral phenomena are frequently seated within the region of the clouds." Hood states that he saw the aurora several times only six or seven miles above the earth's surface; among others, on Oct. 23, 1819, and June 13, 1820. I have observed similar cases. All the facts agree best with the idea that the liberation of the electricity causing the aurora takes place daily within the atmosphere, and that thence it escapes southerly by the three paths I have mentioned. The constant flow of electricity from the north requires in that region a constant supply. This supply must be afforded by the constant flow of the atmosphere to the north from the equatorial regions, where at its very start it is charged with electricity by simple evaporation from the saline waters of the oceans. For it is a well known fact that positive electricity abounds in all vapors from waters only slightly saline. It has long been remarked that terrestrial magnetism and atmospheric electricity seem intimately connected. They cannot depend on geological causes, for we see nothing in the mineral constitution of the globe to produce such variable phenomena. They must depend on the radiations from the sun, either directly in part by changes of temperature, as Faraday thought, or indirectly by some other means, such as evaporation, condensation, friction of atmospheric strata, and the like. Mysterious as the whole subject now appears, it is nevertheless plainly a soluble question, and awaits only the coming man armed fully with physical and meteorological science and having patience to give the problem a few years of undivided attention.

On the production of BRACTEA in LARIX.

BY THOMAS MEEHAN.

I have no desire to press with undue force on my fellow-students in Botany the importance of the discovery I made last year, that many of the great differences we see in varieties, species or even genera in Coniferæ, are resolvable into the simple question of axial vigor; but the key it furnished enables me frequently to unlock some heretofore secret and mysterious